Coupling Between Lattice Distortions and Magnetism in $La_{0.9}Sr_{0.1}MnO_3$ Thin Films.

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Introduction: The structural properties of very thin metal oxide films are of great interest for both the basic physical properties and for the development of the future oxide based technology. Hower a detailed quantitative analysis of the epitaxial strain is still lacking. The need of such analysis is clearly stated by Millis [1], who has pointed out the relevance of lattice distortion and and Jahn-teller electron-phonon coupling to the Colossal Magneto Resistance phenomenon.

Methods and Materials: High resolution X-ray scattering techniques. Reflectivity and grazing incidence diffraction. Study of film crystal structure as function of temperature. The materials used are high quality epitaxial $La_{0.9}Sr_{0.1}MnO_3$ thin films grown by laser ablation. Oxigen stochiometry of the films is checked by Rutherford Back Scattering. The temperature dependence of the structural studies was performed by using a closed-cycle 10K displex.

Results: X-ray scattering measurements have demonstrated that at the first stage of epitaxy (thin films of thickness less than 50 nm) the accommodation between lattice mismatch and substrate gives rise to a long period modulated structure [1]. The non-bulk structural properties are at the origin of the anomalies in the electronic and magnetic behavior [2]. Studies of the lattice as a function of the temperature clearly reveal the strong coupling between lattice and spins, close to the Curie temperature. For thicker films the strain relief mechanism is replaced by the formations of coherent microtwins and some of the bulk properties are recovered, but some differences are still observed.

Conclusions: First observation of a coherent modulated structure as a result of strain relief mechanism, in metal oxide thin films. By a careful study of the lattice as a function of temperature, a strong correlation is observed between structure and magnetism.

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